

**WHAT WE CLAIM IS:**

1           1.       A process for transmitting digital data to an A/D converter via an analog  
2 channel, comprising:  
3           generating a sequence of output signals by precoding a sequence of input signal  
4 points to precompensate for ISI in the analog channel, at least one of the output signals  
5 would be distorted by the ISI to a signal representative of a signal point lying between  
6 quantization levels of the A/D converter if the precoding matches the ISI, others of the  
7 output signals would be distorted by the ISI to signals representative of signal points that  
8 are quantization levels of the A/D converter if the precoding matches the ISI, a majority  
9 of the input signal points are quantization levels of the A/D converter.

1           2.       The process of claim 1, wherein the quantization levels are the  
2 quantization levels of a PCM vocoder.

1           3.       The process of claim 2, wherein the precoding further comprises:  
2 precompensating an input signal point for the ISI; and  
3 adding a modulo amount to the precompensated signal point in response to  
4 precompensated signal point having a value outside of a threshold range.

1           4.       The process of claim 3, wherein the adding includes determining the value  
2 of the modulo amount in a manner responsive to the value of the input signal point that  
3 was precompensated.

1           5.       The process of claim 4, wherein the threshold range is dependent on the  
2 value of the input signal point that was precompensated.

1           6.       The process of claim 4, wherein the threshold range is independent of the  
2 value of the input signal point that was precompensated.

1           7.       The process of claim 1, wherein another of the output signals would be  
2 distorted by the ISI to a signal representative of a signal point lying between quantization

3 levels of the A/D converter, first and second ones of the output signals lying between  
4 different pairs of quantization levels.

1 8. The process of claim 1, wherein each of the input signal points is  
2 representative of a value of a quantization level of the D/C converter.

1 9. A transmitter for transmitting digital data to an A/D converter via an  
2 analog channel, the transmitter comprising:  
3 a precoder being configured to precompensate a sequence of input signal points  
4 for ISI in the analog channel and being characterized by an original constellation and an  
5 extended constellation, a majority of the signal points of the original constellation being  
6 quantization levels of the A/D converter, and the extended constellation including at least  
7 one signal point that is not a quantization level of the A/D converter.

1 10. The transmitter of claim 9, wherein the quantization levels characterizing  
2 a portion of the points in the constellations are quantization levels of a PCM vocoder.

1 11. The transmitter of claim 10, further comprising:  
2 a trellis encoder to produce the input signal points by encoding digital data, the  
3 trellis encoder is coupled to transmit the input signal points to the precoder.

1 12. The transmitter of claim 11, wherein the trellis encoder is configured to  
2 produce signal points representative of the quantization levels of the PCM vocoder.

1 13. The transmitter of claim 10, wherein the precoder trellis encodes the input  
2 signal points and further produces signals representative of signal points of the original  
3 constellation in response to being configured to precompensate for zero ISI in the analog  
4 channel.

1 14. The transmitter of claim 10, wherein the precoder comprises:

2 a digital filter to generate feedback signal points from precompensated signal  
3 points produced from the input signal points by the precoder;  
4 an adder to combine the feedback and associated input signal points; and  
5 a modulo device to produce a signal point within a threshold range from a signal  
6 point received from the adder.

1 15. The transmitter of claim 14, wherein the modulo device is configured to  
2 add a modulo amount to a signal point received from the adder in response to the  
3 received signal point not having a value in the threshold range.

1 16. The transmitter of claim 14, wherein the threshold range is dependent on  
2 the value of the input signal point that was precompensated.

1 17. The transmitter of claim 14, wherein the threshold range is independent of  
2 the value of the input signal point that was precompensated.

1 18. The transmitter of claim 15, wherein the modulo device is configured to  
2 determine the threshold range from the value of the associated input signal point.

1 19. The transmitter of claim 9, wherein the extended constellation includes a  
2 plurality of signal point values that are not equal to quantization levels of the A/D  
3 converter.

1 20. A process for communicating data over an analog channel in both  
2 downstream and upstream directions, comprising:  
3 monitoring a quantity representative of an echo level caused by downstream data  
4 transmission;  
5 resetting a power level for downstream transmissions over the analog channel to a  
6 lower value in response to determining that the echo level interferes with upstream data  
7 transmissions over the analog channel.

1           21.     The process of claim 20, further comprising:  
2     channel encoding data prior to transmitting the data downstream; and  
3           decoding upstream transmitted data to recover the data.

1           22.     The process of claim 20, further comprising:  
2           resetting includes selecting a constellation for the downstream data transmission  
3     that produces a lower average power level on the analog channel.

1           23.     The process of claim 20, wherein the echo level changes the amount of  
2     quantization noise in upstream transmitted data.

1           24.     A transceiver for transmitting and receiving digital data via a mixed  
2     channel that includes a digital network and an analog channel serially connected to the  
3     digital network, comprising:  
4           a transmitter capable of error-encoding digital data and of transmitting encoded  
5     data downstream to a target transceiver via the mixed channel; and  
6           a receiver capable of error-decoding received digital data transmitted upstream  
7     from the target transceiver via the mixed channel, the transmitter configured to reduce  
8     downstream transmission power in response to determining that echo from downstream  
9     transmissions interferes with upstream transmissions from the target transceiver.

1           25.     The transceiver of claim 24, wherein the transmitter is configured to lower  
2     the downstream transmission power in response to determining that the power level  
3     causes an above-threshold noise level in upstream transmissions from the target receiver.

1           26.     The transceiver of claim 24, wherein the transmitter is configured to set  
2     the power level in part by selecting a signal constellation for transmitting data  
3     downstream.

1           27.     The transceiver of claim 24, wherein the transmitter includes a  
2     probabilistic trellis encoder to perform the encoding.

1           28.     The transceiver of claim 24, wherein the receiver includes a Viterbi  
2 decoder and is configured to scale 1D branch metrics used in the decoder in a manner  
3 responsive to reliability information derived from the received digital data.

1           29.     A receiver capable of receiving signals from a mixed channel that includes  
2 a digital network and an analog channel serially connected to the digital network, the  
3 receiver comprising:

4                 a Viterbi decoder configured to process the received signals in a manner  
5 responsive to reliability information derived from the signals, the reliability information  
6 being indicative of potential magnitudes of quantization noise in the received signals.

1           30.     The receiver of claim 29, further comprising:  
2 an adder configured to subtract an estimate of an echo level from each received  
3 signal and to transmit the echo-subtracted signal to the Viterbi decoder; and  
4 a device configured to derive the reliability information from the received signals;  
5 and  
6 wherein the adder and device are coupled to obtain the received signals in  
7 parallel.

1           31.     The receiver of claim 29, wherein the received signals are representative  
2 of signal points belonging to constellations, and the reliability information corresponding  
3 to ones of the received signals is a function of minimum distances of the constellations  
4 associated with the ones of the received signals.

1           32.     The receiver of claim 29, wherein the Viterbi decoder is configured to  
2 scale 1D branch metrics that are used in decoding in a manner that is responsive to the  
3 reliability information.